RECOVERY PLAN

BROOKSVILLE BELLFLOWER *(Campanula robinsiae)*

and

COOLEY'S WATER-WILLOW *(Justicia cooleyi)*

U.S. Fish and Wildlife Service
Southeast Region

RECOVERY PLAN FOR BROOKSVILLE BELLFLOWER (*Campanula robinsiae*) AND COOLEY'S WATER-WILLOW (*Justicia cooleyi*)

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NOTE ON AUTHORSHIP

Richard Hilsenbeck prepared the technical/agency draft of this Plan, incorporating material that David Martin had adapted from the rule (published in the *Federal Register)* that added these plants to the List of Endangered and Threatened Plants. Martin edited Hilsenbeck's draft plan and the final plan.

EXECUTIVE SUMMARY OF THE RECOVERY PLAN FOR BROOKSVILLE BELLFLOWER (*Campanula robinsiae*) AND COOLEY'S WATER-WILLOW (*Justicia cooleyi*)

Current Status: Both species are endangered.

•Brooksville bellflower, a small annual herb, is known from three sites in Hernando County, Florida (north of Tampa). One is on land owned by the U.S. Department of Agriculture, one on state land, the third on private land.

•Cooley's water-willow, a perennial herb, is known from 10 sites, 9 in Hernando County and 1 (recently rediscovered) in Sumter County, Florida.

Habitat Requirements and Limiting Factors: Brooksville bellflower occurs at pond margins, in wet prairies, or in seepage areas in adjacent hardwood forests. Due to its rarity, any habitat alteration such as unnatural fluctuations in water level or quality could be disastrous. Cooley's water-willow grows in rich hardwood forests, often over a limestone substrate. The water-willow is threatened by habitat loss or alteration from urbanization, conversion of forested habitats to pasture, silviculture, and limestone mining. Several exotic plant species are proliferating in Hernando County's forests and threaten both species. Routine roadside maintenance may adversely affect the species, particularly Cooley's water-willow.

Recovery Objective: Delisting.

Recovery Criteria: To develop objective, measurable criteria, we need to better understand the distributions of these plants and the Brooksville bellflower's annual growth cycle. It may be possible to conserve Brooksville bellflower on sites that are presently government-owned. Delisting of both species should become feasible as habitat is protected and new populations are (re)established.

Plausible criteria for recovery might include securing at least 10 viable and self-sustaining populations of Brooksville bellflower in pond margin habitats, consisting of approximately 10,000 individuals during prolific years. For Cooley's water-willow, recovery would require at least 15 viable and self-sustaining populations, totalling at least 10,000 individuals. Population viability at recovery levels must be demonstrated for 10 consecutive years.

Major Actions Needed:

1. Develop management and protection criteria for populations on current managed areas (includes collection of biological/systematic data and control of exotic plants).
2. Acquire additional habitat, or protect habitat through conservation easements and/or regulation. Sufficient information is available to proceed immediately.
3. Conduct additional surveys for new populations of the species.
4. Augment existing cultivated populations, including establishment of a germ plasm bank.
5. Develop plans for possible (re)introduction of plants into suitable habitats (includes 10-year monitoring of existing and/or reintroduced populations).
6. Enforce protective legislation.

Costs ($000's):

Year	Need 1	Need 2*	Need 3	Need 4	Need 5	Total
1994	47.0	5.0	5.0	10.0	8.0	75.0
1995	37.0	5.0	3.0	10.0	9.0	64.0
1996	15.0	0	3.0	5.0	7.0	30.0
1997	15.0	0	0	.0	5.0	20.0
1998	10.0	0	0	.0	5.0	15.0
1999•	0	0	0	3.0	2.0	5.0
2000	0	0	0	0	2.0	2.0
2001	0	0	0	0	2.0	2.0
2002	0	0	0	0	2.0	2.0
2003	0	0	0	0	2.0	2.0
Recovery Cost	124.0	10.0	11.0	28.0	44.0	217.0

*Immediate land acquisition costs, not included in the budget, may total $200,000; acquisition costs for full recovery may be higher.

•The recovery plan doesn't provide a detailed budget for 1999-2002; these are rough estimates.

Date of Recovery: Depends upon implementation of the Recovery Plan. To be effective, conservation efforts must be implemented by about 1995. After that time, increasing development will greatly limit conservation options. Recovery of these species should be attained within 5 years, depending on the outcome of several of the recovery tasks. Delisting can be initiated after 10 years if populations are sustained at recovery levels.

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PART I. INTRODUCTION

Hernando County

Hernando County is located on Florida's Gulf Coast north of Tampa Bay (Figure 3, p.10). The county seat, Brooksville, is 40 miles north of downtown Tampa. The county's population is burgeoning (Table 1), largely because the Tampa-St. Petersburg-Clearwater urbanized area is expanding northward along the Gulf coast. The central and eastern portions of the county are not yet growing so rapidly, and the county's state-mandated comprehensive plan limits the pace and location of population growth. However, proposed road construction and the spread of retirement communities in this part of the State may result in considerable growth, which is evident in population projections. The likelihood of further growth in Hernando County is the principal reason why the two plant species were listed as endangered species. A second reason for the listings is the past destruction of hardwood forest by phosphate and limestone mining and by conversion of forests to pasture (Fish and Wildlife Service 1989).

Table 1. POPULATION OF HERNANDO COUNTY, 1970-1990

year	population (000's)	data source
1970	17.0	U.S. Census
1980	44.5	U.S. Census
1984	61.9	Estimates for month of April by University of Florida, Bureau of Economic and Business Research
1988	85.9	
1989	90.5	
1990	101.1	U.S. Census
2000	150.6	Estimates from Executive Office of the Governor, State Data Center
2020	193.4	

Estimated figures published in *Florida Trend Economic Yearbook*, 1988, 1989, 1990. Census figures for 1970, 1980 from Marth and Marth (1985). Census figures for 1990 and projections from Fla. Dept. of Commerce (1992).

Because of their nearly parallel geographic distributions, apparent rarity, and shared threats, the Brooksville bellflower (*Campanula robinsiae*—Campanulaceae) and Cooley's water-willow (*Justicia cooleyi*—Acanthaceae) were both proposed for Federal listing as endangered species in the same publication, and they were accorded endangered status less than 1 year later, pursuant to the Endangered Species Act of 1973, as amended (U.S. Fish and Wildlife Service 1988, 1989). A single recovery plan has been prepared for both species, to address their mutual conservation needs.

Taxonomic Overview

Campanula robinsiae **(Brooksville bellflower)**

Campanula robinsiae was first collected by John Kunkel Small and Mrs. Raymond Robins in 1924 from the grassy slopes of Chinsegut Hill, on the Robins estate north of Brooksville, Hernando County, Florida. Small (1926) formally published the species, but later (Small 1933) transferred the species to his new genus *Rotantha*, along with *Campanula floridana*, based on the shared character of their rotate corollas[1] (Small 1933). Later workers (Shetler 1963, Wunderlin et al. 1980a) determined that these two species are not closely related, so *Rotantha* is an artificial genus; the two species are retained in *Campanula*.

Campanula robinsiae is treated as a Florida endemic which occupies a very restricted range within the Brooksville Ridge physiographic province. Its presence on Chinsegut Hill, one of the highest points within this area of Florida, suggests that it may be relictual, and could have persisted through Pleistocene interglacial high sea levels and/or glacial dry climate. Small believed that *C. robinsiae* was most closely related to *C. reverchonii*, a species endemic to the Edwards Plateau of Central Texas. Shetler (1963) presented an opposing viewpoint that the species might be an accidental introduction from Eurasia. Rosatti (1986) noted that "the annual habit, the low, divaricately branched, leafy stems, and the basal capsule dehiscence suggest to me that its affinities may lie with species belonging to subsect. Annuae (Boiss.) Fedorov and native to the Caucasus and Mediterranean regions." Ward (1978) also doubted that *C. robinsiae* is a true Florida endemic. However, a more recent review of the systematics of this and other species of *Campanula* supports the idea that this is a very distinctive species native to Florida, rather than an introduction from Eurasia (Shetler and Morin 1986, Morin 1987). The Fish and Wildlife Service accepted these recent publications as representing the best available scientific information when it listed *Campanula robinsiae* as an endangered species. A definitive answer to the question of whether the species is an endemic or a Eurasian introduction may come only when a monographic treatment of the Eurasian species of *Campanula* is published.

Justicia cooleyi **(Cooley's water-willow)**

Justicia cooleyi was also first collected by J.K. Small in 1925, reportedly near Mascotte, Lake County. The species was later collected in Hernando County, also near Chinsegut Hill, by Small and others, including George Cooley. Joseph Monachino and Emery Leonard (1959) later described the species, designating as the type Cooley's specimens from Indian Hill, 2 miles northwest of Chinsegut Hill. Although the taxonomy of *Justicia*, the largest genus of the Acanthaceae, has been in a state of flux for years, no realistic or accepted alternative generic placements have been proposed for this distinctive species (Long 1970, Meagher 1974; however, see Bremekamp 1965 for proposed subgeneric and sectional classification in Acanthaceae).

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[1] A rotate corolla is wheel-shaped, with a short corolla tube (the "axle") and a wide limb (the "hub and spokes") at right angles to the tube.

There has been continued speculation as to whether or not *Justicia cooleyi* is truly endemic to Florida or perhaps an introduction. Robert W. Long (pers. comm. to Hilsenbeck 1974) and Daniel F. Austin (pers. comm. 1992) have suggested that because of this species' distant taxonomic affinities to other members of the genus in Florida, its somewhat weedy behavior, and its presence in an area where other plants were introduced, it might indeed represent an introduced and naturalized tropical taxon of this large and still poorly known genus. The species appears to be most closely related to either Mexican or Caribbean taxa of *Justicia*, and bears little morphological relationship to the other four Florida species of this complex genus (Meagher 1974, Hilsenbeck, unpubl. obs., Ward 1978). For a discussion of infrageneric groups within New World *Justicia* see Hilsenbeck (1983, 1989, 1990) and Meagher (1974). Despite lingering doubts about the endemic status of this plant, it is worth remembering that Florida has many native species of Mexican or Caribbean affinities, and that *Justicia cooleyi* is documented as having been present near Mascotte since the 1920's, well separated from the gardening activities at Chinsegut Hill.

Descriptions and Habitats

Campanula robinsiae **(Brooksville bellflower)** (figure 1, p. 4; appendix 2, p. 33)

Campanula robinsiae is an annual herb, with stems 1-15 cm^2 (0.5-6 in.) tall, very slender, simple or branched, faintly winged or 4-angled. The stems are glabrous except for a few trichomes in the angles (Morin 1987). The plant may be submerged for part of its life, which may affect its growth. Some stems root at the nodes (Morin 1987). The leaves are alternate, the blades varying in size and shape on different parts of the plant and from plant to plant (Morin 1987). Open flowers are solitary, 3-10 mm long, bell-shaped, "deep purple" (Morin 1987). Steven Leonard (under contract to The Nature Conservancy; report at Florida Natural Areas Inventory) discovered in 1983 that the plant has cleistogamous (closed, self-pollinating) flowers, which are quite small. This is the only North American *Campanula* with cleistogamous flowers (Morin 1987). The fruit is a subglobose capsule about 2 mm in diameter (Wunderlin et al. 1980a). The seeds are about 1 mm long, the smallest of any North American member of the genus (Shetler and Morin 1986; description adapted from Wunderlin et al. [1980a] and other sources as noted). Leonard observed only cleistogamous flowers on February 8 and 11, 1983, and did not see a chasmogamous flower until February 23 (letters from Leonard to Morin *in* Morin 1987). Flowering specimens have also been collected March 11, 1983; April 13, 1983; and April 26, 1958. Seed production proceeds while flowering continues. *Campanula robinsiae* may be confused with *Campanula floridana*, but the latter species has very different seeds and leaves that are "much firmer than those of *C. robinsiae*" (Morin 1987).

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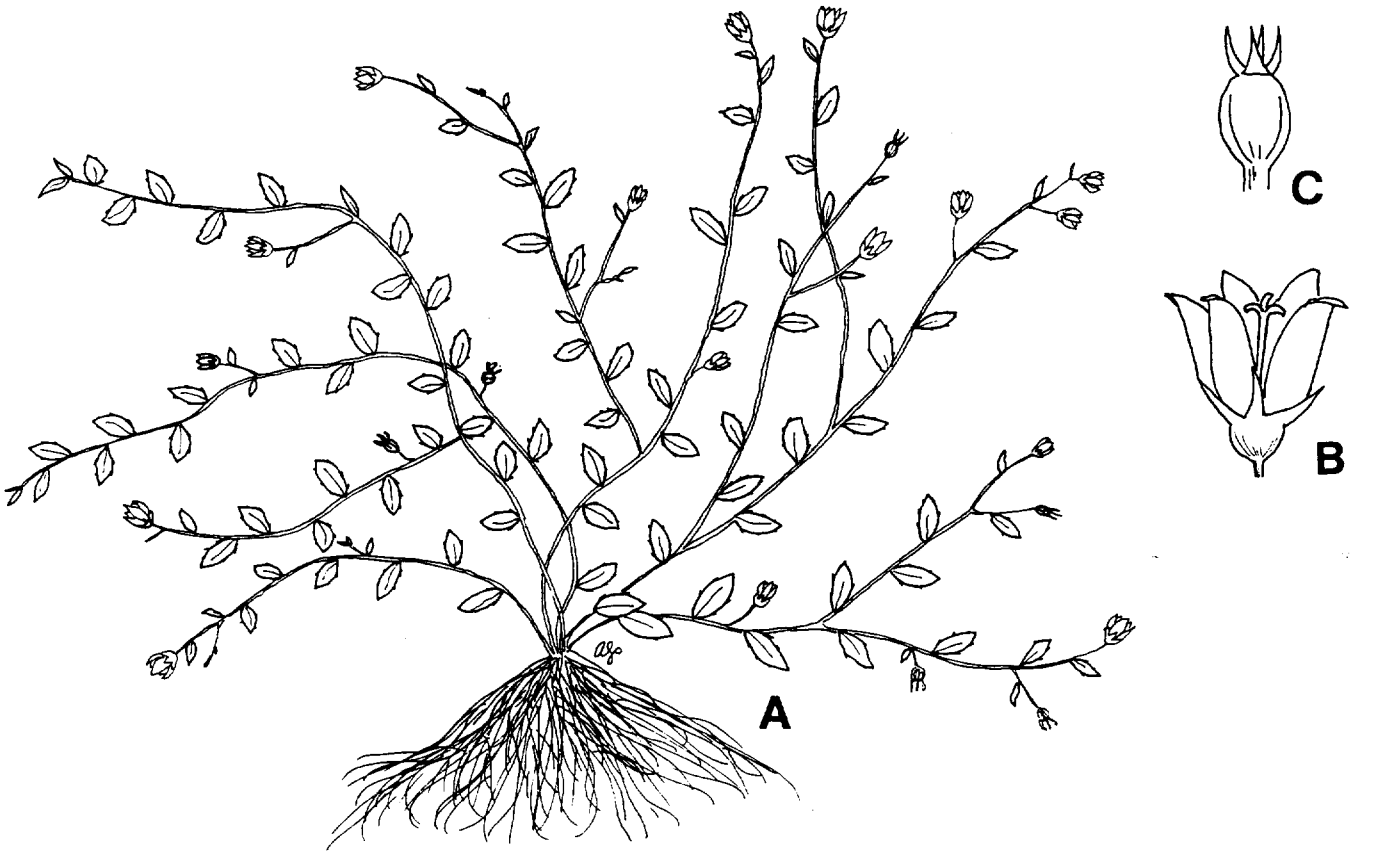
[2]measurements: cm = centimeter, mm = millimeter, in. = inches, ft. = foot

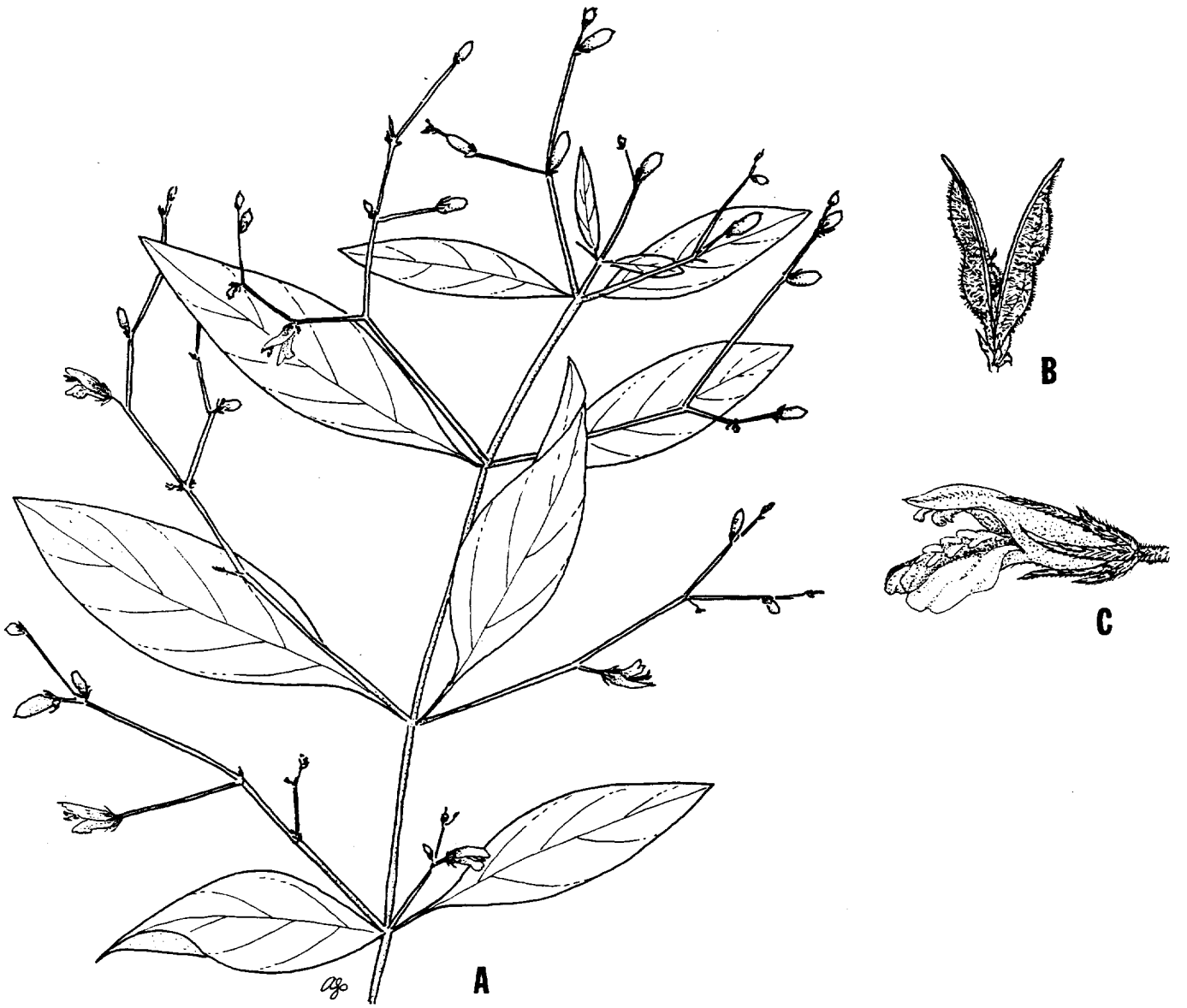
Figure 1: Illustration of Brooksville bellflower (*Campanula robinsiae*)



A. Plant, B. Flower, C. Fruit.

Illustration by Anna-Lisa King, in Status report on *Campanula robinsiae* by R.P. Wunderlin, D. Richardson, and B. Hansen. 1980.

Figure 2: Illustration of Cooley's water-willow (*Justicia cooleyi*)



A. Plant, B. Seed pod, C. Flower.

Illustration by Anna-Lisa King in Status report on *Justicia cooleyi* by R.P. Wunderlin, D. Richardson, and B. Hansen. 1980.

Campanula robinsiae is currently known to occur only at Burns Prairie, Lake Lindsey, and a moist pasture on Chinsegut Hill. The plant may occur at similar sites in the vicinity that have not been checked. Because the bellflower is an annual whose seeds apparently germinate in the winter or spring, and perhaps not every year, it is not easy to determine the plant's distribution. The species is associated with typical wetland plants such as mosquito fern (*Azolla caroliniana*), hair sedge (*Bulbostylis* spp.), coinwort (*Centella asiatica*), button snakeroot (*Eryngium* spp.), pennywort (*Hydrocotyle* spp.), rush (*Juncus* spp.), pimpernel (*Anagallis minima*), pearlwort (*Sagina decumbens*), and maidencane (*Panicum hemitomon*).

Justicia cooleyi **(Cooley's water-willow)**(fig.2, p.5; appendix 2, p. 34)

Justicia cooleyi is a rhizomatous perennial herb usually no more than 40 cm (about 1.3 ft.) tall, with erect stems. The stems are slender, somewhat squared in cross section, hairy, somewhat zig-zag, with few branches. Leaf blades are ovate or lanceolate, up to 5 cm (2 in.) long, the surfaces bristly-hairy. The flowers are sessile on paired, zigzag spikes. The flowers somewhat resemble miniature snapdragons. The corolla consists of a tube and two lips totalling 7-8 mm long. The corolla is bright lavender-rose; the lower lip is longer than the upper and has a strip of mottled lavender and white down its middle. All flower parts except the stamens are hairy. The capsule is finely hairy, about 1.2 cm (.47 in.) long (Kral 1983; Perkins 1978). Flowering occurs at least from August through December and probably continues sporadically through March (Kral 1983, Wunderlin et al. 1980b). *Justicia cooleyi* is distinguished from the only other *Justicia* in this area, *J. ovata*, "by its thinner leaves, its generally pilose-pubescent surfaces . . . its much smaller, much brighter colored corollas" and by unique hairs on its seeds (Kral 1983).

Small collected the first specimen of *Justicia cooleyi* in a "low hammock" (hardwood forest) near Mascotte, Florida, in 1925 (Monachino and Leonard 1959). Mascotte is in Lake County, so the specimen was assumed to have been collected in Lake. There was speculation that Small had perhaps actually collected his material at Chinsegut Hill, and had mislabeled it as having been collected at a different point in his itinerary until recently, when the plant was collected near Mascotte (in Sumter, not Lake County). Although Small's collecting trips were very carefully organized, specimens were occasionally mislabelled (Austin et al. 1987).

Until recently, all collections since Small's time, all collections of *Justicia cooleyi* came from hardwood or hardwood-pine forests in north central Hernando County (including Chinsegut Hill), on fine sandy loam to silty clay loam soils, typically underlain by limestone, that range from moist to seasonally wet. The overstory is mainly hardwood species, including southern magnolia (*Magnolia grandiflora*), black gum (*Nyssa sylvatica*), cabbage palm (*Sabal palmetto*), pignut hickory (*Carya glabra*), laurel/diamondleaf oak (*Quercus laurifolia*), live oak (*Quercus virginiana*), water oak (*Quercus nigra*), winged elm (*Ulmus alata*), sweetgum (*Liquidambar styraciflua*), and sugarberry (*Celtis laevigata*) (Wunderlin et al. 1980b). The understory may include American hornbeam (*Carpinus caroliniana*), eastern hophornbeam (*Ostrya virginica*), and especially yaupon (*Ilex vomitoria*). Herbs include many ferns belonging to *Athyrium,*

Polypodium, Nephrolepis, Asplenium, Dryopteris; woodland grasses belonging to *Panicum, Chasmanthium,* and *Oplismenus*; sedges; and herbs including *Mitchella repens* (partridge berry)(Kral 1983). Near Stafford Lake, *Justicia cooleyi* occurs with dwarf spleenwort fern (*Asplenium pumilum*), sinkhole fern (*Blechnum occidentale*), Tampa verbena (*Glandularia tampensis*), and a mint (*Pycnanthemum floridanum*) (Dennis Hardin, Florida Natural Areas Inventory, pers. comm. 1987). At a wooded roadside, the ground cover consisted of typical roadside grasses and herbs, including the grasses *Chloris glauca, Panicum commutatum,* and *Paspalum setaceum*, the sedge *Cyperus globulosus*, *Scleria triglomerata*, beggar-ticks (*Desmodium perplexum*), *Iresine ramosissima*, a mint (*Hyptis mutabilis*), a milk-pea (*Galactia volubilis*), a rattle-box (*Crotalaria lanceolata*), and *Croton glandulosus* (Wunderlin et al. 1980b). Kral (1983) noted that most of the area from which *Justicia cooleyi* is known had been logged, and that some areas of forest had been "opened up" for grazing by selectively removing trees; *Justicia cooleyi* appeared to be thriving in such woods. Kral estimated that burning, bulldozing, root raking, bedding, chopping, or clearcutting the overstory would probably destroy this, along with most of the other, woodland understory species.

The relation of hardwood forests to longleaf pine-turkey oak-wiregrass vegetation (high pinelands or sandhills vegetation) is of interest with respect to *Justicia cooleyi*. Succession of a longleaf pine-wiregrass community has been documented at a site where burning ceased sometime before 1932. The present-day hardwood forest has swamp chestnut oak (*Quercus michauxii*), live oak, water oak, American hornbeam, hophornbeam, and sweetgum (Beckwith 1968, Hartnett and Krofta 1989). It would be relevant to know whether *Justicia cooleyi* and other endemic plants occur in such new hardwood forests, or whether they are confined to older stands. Barry Wharton (pers. comm. to Martin 1986) has researched historic maps of the county, Roland Harper's work, and nineteenth century General Land Office surveys. These sources make it possible to reconstruct Hernando county's vegetation at the start of American settlement and vegetation changes since then. Such historical information may help guide searches for *Justicia cooleyi* and to interpret the history of sites where the plant occurs.

Distributions and Ownership

The Brooksville bellflower and the Hernando County populations of Cooley's water-willow appear to be restricted to the Brooksville Ridge, a 100-mile long area of high ground dotted with lakes or wet prairies in sinkhole basins, with its highest elevations and greatest local relief in Hernando and neighboring Pasco counties. The highest point in Hernando County is Chinsegut Hill, elevation 274 feet, a high hill by Florida standards (the highest point in the Florida peninsula is apparently Sugarloaf Mountain west of Lake Apopka at 310 feet). The southern Brooksville Ridge in northern Pasco, Hernando, and southern Citrus counties has relatively fertile, phosphate-rich soils that support one of the southernmost areas of upland temperate hardwood forest in Florida. Hernando County's hardwood forests have rich floras, including substantial numbers of species listed by the State, as well as candidates for Federal listing (Appendix 1, p.32). Similar soils with hardwood forests extend north through the Ocala and Gainesville areas. These southeastern upland mixed deciduous-evergreen hardwood forests

contrast with the pinelands that are characteristic of most of Florida. The soils and forests are shown clearly in Raisz et al. (1964, maps 14 [soils] and 15 [natural vegetation, based on a larger-scale map by John H. Davis]). A more recent map of Statewide soils is also available (Caldwell and Johnson 1982). The Hernando County soil survey (Soil Conservation Service 1977) shows that the upland hardwoods occur primarily on two soil associations:

- Arredondo-Sparr-Kendrick association (eastern and western portions of the Brooksville Ridge; covers 16 percent of the county)
- Nobleton-Blichton-Flemington association (central portion of the Brooksville Ridge, including the higher hills; covers 22 percent of the county).

Government agencies own and manage habitat for both the Brooksville bellflower and Cooley's water-willow. Much of this land constituted the Chinsegut National Wildlife Refuge from the 1930's to the 1970's, when the Refuge closed and the property was divided. The current landholders are:

- U.S. Department of Agriculture, Agricultural Research Service, Subtropical Agricultural Research Station (USDA/ARS)(both species)
- U.S. Department of Agriculture, Soil Conservation Service, Plant Materials Center (USDA/SCS)(*Justicia cooleyi*)
- University of South Florida, conference center (neither species known on the site)
- Florida Game and Fresh Water Fish Commission (GFC), Chinsegut Nature Center (including a tract transferred from the University of Florida in 1989)(*Campanula robinsiae* and seemingly suitable habitat for *Justicia cooleyi*).
- Florida Department of Agriculture and Consumer Services, Division of Forestry (FDF), Withlacoochee State Forest (*Justicia cooleyi*)(J. Blanchard, FDF, *in litt.* 1994).

Impacts and Threats

Justicia cooleyi **(Cooley's water-willow).**

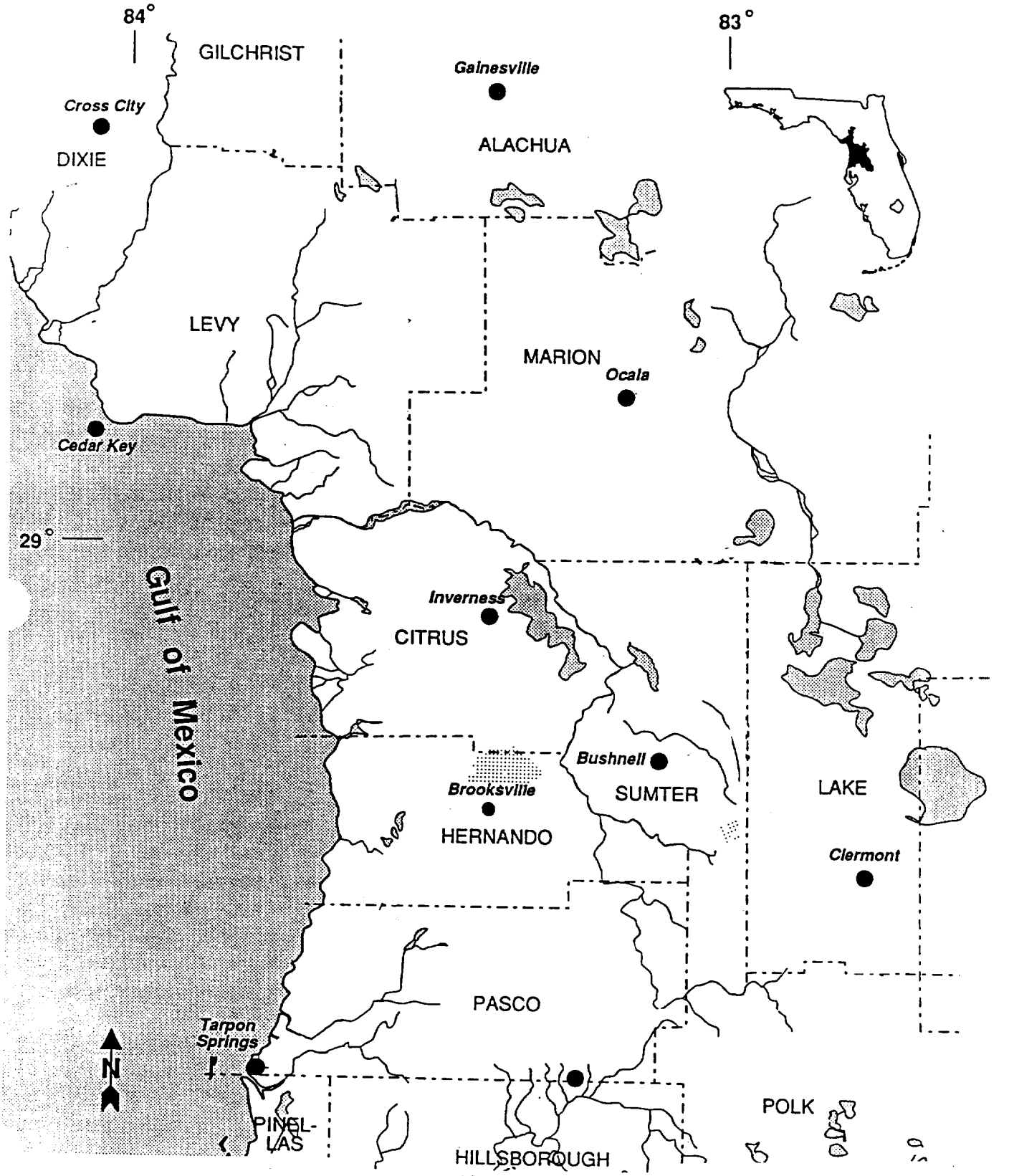
The principal threat to this species is that its habitat is being destroyed as Hernando County urbanizes. According to a Census Bureau report, Hernando was the nation's second fastest-growing county, growing by 74.8 percent from 1980 to 1986 (*The New York Times*, September 1, 1987). The University of Florida's Bureau of Economic and Business Research, the Withlacoochee Regional Planning Council, and 1990 census figures all confirm this rapid growth (Table I, p.1). The proposed Suncoast Corridor (a toll road to the Tampa Bay area with possible provision for rapid rail transit) has the potential to stimulate residential development, similar to the Beeline Expressway toll road east of Orlando, which in the 1980's became a magnet for planned communities and other Developments of Regional Impact.

Hernando County's limestone mining industry appears to be a direct threat to *Justicia cooleyi*. The Hernando County soil survey (Soil Conservation Service 1977) reported that "six limestone mines produce more than one-half million tons of rock annually. This rock is used in road construction throughout the State as well as for plastering, soil conditioning, and gravel for roofing, concrete, and other uses." The survey's aerial photographs show the extent of mines and quarries in the mid 1970's. At that time, most of the land disturbance appears to have been

due to the phosphate mining industry that operated from 1883 to 1966 (Deuerling and MacGill 1981, cited in Wolfe, in press). Presumably the limestone industry needs only limited areas for quarries and these need not be a critical threat to *Justicia cooleyi* or *Campanula robinsiae* if potential mining impacts can be addressed in the County comprehensive plan. According to the recent survey of Hernando County for both species (Chicardi 1992, prepared for the Florida Natural Areas Inventory), Cooley's Indian Hill collection site for *Justicia cooleyi* is now occupied by a portion of the Brooksville Quarry, a limerock mining operation of Florida Rock. An excerpt from the report (Chicardi 1992) states, "Aerial photography from 1980 shows that the vast majority of *Justicia cooleyi* habitat in this area [Brooksville Quarry] had been destroyed or greatly reduced, with greater destruction likely in the 12 years since then. Some areas harboring populations of this species may persist; however, repeated attempts to gain access through the mining property by myself and others have been met with futility. This is not surprising, given the currently proposed Hernando County 'Mining Ordinance,' which will probably cause major issues to be addressed by mining companies in the future. . ."

A more recent threat to *Justicia cooleyi* (and to some extent *Campanula robinsiae* at Chinsegut Hill) is the spread of rapidly proliferating, exotic plant species, especially skunk vine (*Paederia foetida*) and air-potato (*Dioscorea bulbifera*), which pose threats at several of the known sites of *J. cooleyi* (including Chinsegut Hill, where both of the endangered species are known). For example, with regard to a *J. cooleyi* site near Croom Road (CR 478), Chicardi (1992) states, "Two common and problematic exotic species are encroaching into this area as well. Skunk vine *(Paederia foetida)* is becoming all too common throughout Hernando County. Its habit of forming dense ground cover often excludes native species. Although it has not reached such an advanced stage on this site, it bears careful observation. Air-potato *(Dioscorea bulbifera)* may be an even more severe 'exclusion species' and occurs in fairly large numbers just south of the *Justicia* colony along the old roadway." With regard to the Chinsegut Hill property, Chicardi (1992) states, "A fairly large (several thousand estimated) population of *Justicia* and an unknown number of *Campanula robinsiae* occup[y] a north-facing seepage slope area in the northwestern portion of [this property] . . . Because of the nature of the Chinsegut Hill property (i.e., since it was established in the 1880's as a botanical garden for the Robins family), exotic species invasion is [a] major problem on this site. The 'nature trails' area is completely covered by a dense growth of *Dioscorea* [air-potato], wandering jew *(Tradescantia fluminensis),* and skunk vine, with scattered clumps of banana *(Musa nana),* sago palms *(Cycas* sp.), and bamboo *(Bambusa* sp.) in the eastern half. A graveled road separates this exotic milieu from the *Justicia* and *Campanula* station and has fortunately precluded all but the skunk vine from covering this area. Control of exotics should be the main focus of preserve management on this otherwise protected site." With regard to the McKethan Lake site (FDF), "the biggest threat is exotics. In addition to the ubiquitous skunk vine, *Ardisia crenata* is thick throughout the site and expanding rapidly; it is of immediate concern. *Imperata cylindrica* [cogon grass] is within 100 m and closing in, but has not yet had a direct effect. The density of the hammock seems to be keeping the cogongrass temporarily at bay. Control of exotics will be essential to survival at this location." (Jon Blanchard, Central Florida Ecologist, FDF, *in litt.* 1994).

Figure 3. Distribution Map of *Campanula robinsiae* and *Justicia cooleyi*.



Campanula robinsiae **(Brooksville bellflower).**

This species is currently known to occur at only three sites. Its main known habitat (Burns Prairie) is divided between a U.S. Department of Agriculture/Agricultural Research Service (USDA/ARS) facility and a tract administered by the Florida Game and Fresh Water Fish Commission. A second site is on the Agriculture facility in a seepy area in a pasture on the north slope of Chinsegut Hill. Both sites can be considered relatively protected. The other known site is at Lake Lindsey, in private ownership. The main threat to *Campanula robinsiae*, apart from unintentional mismanagement of the known sites, may be from changes in quality or quantity of runoff from surrounding watersheds. Because it is so small and short-lived, *Campanula robinsiae* may be easily overlooked. For this reason, further searches might reveal more sites with this species. At Chinsegut Hill, the species is threatened with displacement and/or extirpation by the aggressive, exotic skunk vine.

Conservation and Research Efforts

There is currently little in the way of conservation efforts being undertaken for either species. Susan Wallace, while she was at Bok Tower Gardens (BTG) in Lake Wales, Florida, cultivated *Justicia cooleyi* in association with, and under the strict guidelines of, the Center for Plant Conservation (CPC). The species grows rather easily from seed. Seed-grown accessions of this perennial herb can be maintained in greenhouse or garden plots indefinitely. In fact, the species sets abundant fruit/seed under cultivation and perpetuates itself within the cultivated setting (Susan Wallace, pers. comm., and R. A. Hilsenbeck, pers. obs). The new Curator of Endangered Plants at BTG, Tammera Race, has stated that the CPC and BTG would, if appropriate, play a role in the recovery of *Campanula robinsiae*. She has expressed particular interest in propagating *C. robinsiae* and thinks that work at BTG could be an aid to understanding the species' natural history (Tammera Race, pers. comm. to Hilsenbeck). Nurseryman Robert McCartney of Woodlanders, Inc., in Aiken, South Carolina, had similar success in cultivating *Justicia cooleyi*. He points out that this species might be "useful as a parent in some future breeding program aimed at producing more garden-worthy Justicias. The species may impart intense flower color, vigor, or other desirable characteristics to a hybrid with more or larger flowers."

The Federal land managers where the two species are known to occur (i.e., the USDA/ARS Subtropical Agricultural Research Station and the USDA/SCS Plant Materials Center) are aware of the presence of the species on their lands and are interested in their proper management. For example, staff at the USDA Plant Materials Center have located approximately 50 plants along their North Nature Trail between trail markers 14 and 20. The recent discovery of a bacterial or fungal pathogen that affects a good percentage of the individual plants at this site prompted the staff to seek the pathogens' identity and to prescribe treatment.

While there is evidently no on-going systematic research being conducted on either species, Shetler and Morin (1986) studied the seed morphology of North American Campanulaceae, including *C. robinsiae*. Their conclusions with regard to the taxonomy (and native status) of this

species are briefly stated above, in this plan. It would be worthwhile to reassess the taxonomy of *Justicia cooleyi*. Systematists with experience in *Justica* include Richard Hilsenbeck at the Florida Natural Areas Inventory (phytochemistry, pollen morphology), Dieter Wasshausen at the U.S. National Herbarium (morphology) or Thomas Daniel at the California Academy of Science (cytogenetics). Meagher's (1974) work provides a good foundation for continued studies of this species.

The Florida Natural Areas Inventory reexamined known populations in the field and searched for new localities for both species in September, 1992. Their discovery of a large population of *Justicia cooleyi* in Sumter County near Mascotte, in the vicinity of Small's original collection, confirms that Small almost certainly did collect the species in this area. This new occurrence is more than 20 miles east of all other recently known populations. This significant new locality lends further credibility to the native status of *J. cooleyi* as having been present in Sumter County for over 60 years in an area well separated from the gardens of Chinsegut Hill, a much more likely site for it to have been introduced. The discovery of the Sumter County population expands the known range of the species to two counties, and may also allow for more expedient recovery of the species. The new locality makes it even more likely that future searches of the Citrus-Hernando-Sumter tri-county area may produce more new populations.

PART II. RECOVERY

A. Objectives and Recovery Criteria

The primary objective for the present recovery plan is to prescribe actions that should lead to a condition where delisting of both *Campanula robinsiae* and *Justicia cooleyi* is possible. It should be noted that there is a fundamental lack of basic biological (i.e., distributional, ecological, reproductive, systematic) knowledge about these species, which make it difficult to set "objective, measurable criteria which, when met, would result in a determination . . . that the species be removed from the list" of endangered and threatened plants (Endangered Species Act, as amended 1988, section 4(f)(1)(B)(ii)).

With this caveat clearly set forth, plausible preliminary criteria for the recovery of these species might include attaining at least 10 viable and self-sustaining populations of *Campanula robinsiae*, consisting of an average of 10,000 individuals during prolific years, in northern Hernando County; for *Justicia cooleyi*, a plausible recovery criterion might be to attain at least 15 viable and self-sustaining populations, totalling at least 10,0000 individuals. Population viability at recovery levels must be demonstrated for 10 consecutive years.

As new data about these species are collected and various recovery tasks are accomplished, the preliminary criteria should be reevaluated and, where necessary, modifications made to future revisions of the Plan.

To reach these recovery objectives, the following actions are recommended (note—these apply to both species, but with certain aspects emphasized for one or the other species as appropriate):

1. Develop management plans for populations on current managed areas (includes collection of biological/systematic data and control of exotics for all sites).
2. Protect additional lands containing the species through purchase, conservation easements, or other means.
3. Conduct surveys to find new populations of the species.
4. Augment existing cultivated populations, including possible establishment of a germ plasm bank.
5. Develop plans for possible (re)introduction of plants into suitable habitats (includes 10-year monitoring of existing and/or reintroduced populations).

B. **Narrative Outline of Recovery Actions**

1. **Develop and implement management and protection criteria for populations on currently managed areas (includes collection of biological/systematic data and control of exotics).** Because it is essential for the survival of these species to protect populations of both of these species (particularly *Campanula robinsiae*) on lands that are already owned by government agencies, the first recovery action is to take short-term measures to secure these sites while collecting the information needed to prepare a longer-term management plan. Additionally, the management criteria and biological data gathered for species on public lands are readily applicable to those populations currently on private lands.

   1.1 **Secure known sites within the governmentally-owned lands.** Identify all sites containing either species and provide immediate protection of the species from known or potential threats (e.g., land clearing, exotics invasion [see task 1.321], requirements to sell "surplus" land not needed for the agencies' missions). This action should prevent any loss of the species on these sites by preventing habitat degradation and population decline of already reasonably protected populations.

   1.2 **Initiate biological studies to acquire data necessary for protective management strategies.** Because there is a dearth of biological knowledge concerning each species, several studies should be initiated to gather needed data. As noted above, these data should be fully applicable to populations on private lands and, indeed, the recommended biological studies will likely have to encompass investigations of the privately held populations, provided that permission from land owners can be obtained.

      1.21 **Determine habitat and population/reproductive requirements.** An effort should be made to determine why certain tracts of upland hardwood forest (for *Justicia cooleyi*) or karst pond margins (for *Campanula robinsiae*) support the species, while others do not. Answers should be sought to questions such as what is different about the species composition and community structure of those habitats that support the species, compared to areas that do not. The effects of soils and underlying rock formations (i.e., edaphic factors) on the distribution and abundance of the species should be determined. Vegetation history of an area may also be important; *Justicia cooleyi* perhaps does not occur in hardwood forests that have recently developed on former longleaf pine sites. An examination of any particular or unique microclimatic requirements of these species should also be pursued. A particularly important question may be whether seed dispersal limits the opportunity for both of the species to spread into new, seemingly suitable, habitats or whether there is some other intrinsic or extrinsic barrier to establishment of these species into adjacent habitats. In conjunction with these latter studies, an investigation of the breeding system and pollinators of each species should be initiated. This task is considered to provide minimal information needed to plan conservation management for these species.

1.22 **Study relationship between hydrology and reproductive success.** Because of the annual nature of *Campanula robinsiae* and its apparently very narrowly restricted habitat around the edges of karst ponds, the Subtropical Agricultural Experiment Station and Chinsegut Nature Center need to know how best to manage Burns Prairie and other sites where this species occurs. For *Campanula robinsiae* an examination of the Burns Prairie site (and other karst pond sites) needs to be undertaken by a hydrologist to determine normal water level fluctuation cycles. Because it is unknown how these annual cycles affect the species' reproductive cycles, a botanist/ecologist should examine the effects of cyclical changes in water levels on seed germination success/failure, phenology, and overall growth and reproductive success. Such studies should include an evaluation of stages in the life cycle of *Campanula* that are the most vulnerable to disruption by ecological perturbations (i.e., are seed germination and seedling establishment affected by water quality and quantity parameters?). These latter studies should be conducted in conjunction with those outlined in task 1.21 above. These studies are essential for proper management of the habitat of *Campanula robinsiae.*

There appears to be no need to collect information on the population biology of *Justicia cooleyi*, except to the extent needed to plan management of government-owned habitat (for example, good quality habitat occupied by *Justicia* is grazed by livestock; there seems to be no need to study the effects of grazing on *Justicia cooleyi* unless a major change in management is anticipated).

1.23 **Conduct any needed taxonomic/systematic studies of the species.** Although a body of evidence indicates that both of the species are native to Florida and should be regarded as narrowly restricted endemics, any remaining suspicions that one or both species may be introduced should be confronted. A modicum of funding should be allocated to assist with comprehensive, taxonomically-oriented (i.e., monographic) studies on both genera. However, the large sizes of the genera *Campanula* and *Justicia*, as well as the fact that both are well represented in the Old World, will greatly complicate any expedient completion of monographic studies. As our knowledge of the systematics of *Campanula* and *Justicia* advances, reevaluation of the systematic status of *Campanula robinsiae* and *Justicia cooleyi* should occur. In the unlikely case that either species should prove to be an exotic, it would be delisted.

Collecting up to several dozen plants per year for scientific purposes should not be detrimental to either species. Collecting such material from Federally-owned land would require a permit issued by the Fish and Wildlife Service. Collecting from state or private lands requires written permission from the landowner and a permit from the Florida Department of Agriculture and Consumer Services, Division of Plant Industry.

1.3 **Cooperate with governmental land owners/managers to analyze sites and establish management plans**. For each of the known populations on federally- and state- owned land, a thorough site description and environmental analysis should be performed, and a detailed management plan prepared (right-of-way populations need to be treated differently than populations on tracts of native vegetation. Probably, an overall management plan should be prepared for conserving native plants on rights-of-way). Preservation of the existing populations of these species on government-owned lands is essential to prevent their extinction because, at the present time, they are not assured of being protected anywhere else. Site analysis and planning is not to be done without the full participation (or at least oversight) of land managers.

1.31 **Conduct site analyses.** Analyses should include a census of each population, evaluation of its present condition (i.e., population status), and actions needed to prevent population decline and maintain population integrity.

1.32 **Prepare management plans**. Detailed plans will be prepared, based on the site analyses and preliminary results of biological research conducted under task 1.2.

1.321 **Specify actions to diminish threats identified for each site**. Examples include measures to ensure water quality and quantity, an estimate of the effects of forest canopy clearing/thinning, use and timing of herbicide application along highway rights-of-way, and measures to maintain and/or augment the populations. As determined through site analysis and research, the management plans should preserve population integrity and seek to ensure population viability. Governmental landowners include the USDA/ARS, USDA/SCS, GFC, FDF, the Florida Department of Transportation, and the University of South Florida. Monitoring of populations is included in task 5.3. Any ongoing education/briefing of land management personnel should be included.

1.322 **Control invasive exotic species in known habitat of both species**. Most sites with these species need long-term exotics control, to prevent the extirpation of the species at infested sites and to eradicate the exotics before they become better established and even costlier to control (short-term exotic control is in task 1.1). The Florida Department of Transportation, which is already controlling cogon grass (*Imperata* spp.) on road rights-of-way, will be encouraged to continue this work. Dr. Danny Colvin of the University of Florida Department of Agronomy may be able to assist with planning exotics control.

The efforts of the Florida Pest Plant Council and others to disseminate information on Florida's noxious plant problems deserve support. In particular, better official recognition of the extent of the skunk vine and air-

potato problems may be helpful to land managers. *Resource management notes*, published by the Florida Department of Environmental Protection, has become a valuable source of information for land managers and is a very good forum for pest plant information.

Serious conflict between pest plant control and conservation of these endangered plants is not anticipated, because the pest plants smother other species in their habitats, and because preventing further spread of pest plants is generally more important than attempting to save small numbers of listed species in their vicinities. Both of the endangered plants in this plan are locally abundant and can tolerate small losses for long-term habitat conservation.

1.33 **Implement management plans**. All public land managers should engaged in the development of management plans, and they should be aware of the importance of these species, their distributions and ecologies, how to identify them, and how to conserve them. Monitoring (task 5.3) will be a very important part of implementation.

2. **Conserve additional lands containing the species through acquisition, conservation easements, and/or regulation**. Because both potential and actual habitat of both species is rapidly diminishing within their ranges, particularly in Hernando County, acquisition of lands encompassing populations of the species should be sought immediately. Along with protecting known populations on currently government-owned lands, this is probably the most realistic recovery action that can be taken. Acquisition of these lands will be necessary to meet the recovery objective of ultimate delisting of both species, especially *Justicia cooleyi*. Because of the need to act expediently in this regard, it is better to act on existing information rather than to delay beginning land acquisition until after exhaustive surveys have been conducted.

2.1 **Acquire private lands containing the species as based on currently known distribution and populational data**. Because population growth in Hernando County is proceeding so rapidly (with mining an additional problem), there is a crucial need to acquire and protect lands encompassing these species before irreplaceable habitat is lost. Because of the immediacy of the threat, and because land values are increasing, there should be an immediate expenditure to acquire the best available lands for the conservation of these species and their habitats. Without the protection of additional populations on now privately held lands, particularly for *Justicia cooleyi*, ensuring that the plant does not go extinct may be impossible. The lands targeted for these initial acquisition efforts should be those that contain the largest known populations within the best quality and most defensible habitats. Considerable data are available to guide these acquisition efforts. These sites need not be large to successfully conserve this species. Although conservation easements and other innovative resource protection measures (e.g., transfer of development rights, registry agreements) should be vigorously pursued (see task 2.3

below), much of the acquisition will likely have to be fee simple in nature. Seemingly less costly alternatives such as conservation easements may be nearly as costly, while failing to produce tangible property to show for the expenditure of taxpayers' money, and failing to obtain long-term control over the target resource(s).

Purchase of land to protect these two species is also likely to protect other plants of special concern (Appendix 1, p. 32).

2.2 **Locate suitable source of funding for land acquisition efforts**. In addition to any available Federal government funds, proposals should be made to the State of Florida's Conservation and Recreation Lands (CARL) program for protection of these species. The CARL program has received annual funding in the hundreds of millions of dollars. Among other objectives, CARL seeks to conserve the state's biological diversity through the protection of rare and endangered species and their habitats. Some local governmental funding could also be sought, such as through Hernando County's recently-initiated environmentally endangered lands program.

2.3 **Seek non-acquisition methods of protecting the species and their habitats**. Private conservation organizations such as The Nature Conservancy may effectively use of their resources in contacting landowner, brokering specific contracts, and seeking conservation easements and registry agreements. Assisting private landowners with exotic vine problems could be very productive.

2.4 **Use governmental regulation to protect the species and their habitats**. Because the ponds and prairies inhabited by *Campanula robinsiae* are wetlands, they are protected by State and Federal regulations. Because of the local topography, there seems to be little threat of extensive filling or drainage of these ponds. Threats to water quality include excessive nutrients, pesticide runoff, sediments, and excess runoff from streets and parking lots. They can be addressed through State and Federal regulation. Conservation of occupied habitat should be sought through county planning procedures that are reviewed by the State's Department of Community Affairs and the Withlacoochee Regional Planning Council. For habitat currently owned by government agencies or private conservation organizations, steps should be taken to ensure that the habitat is appropriately managed to benefit the species. Conservation decisions should consider other plant species that collectively give some of the upland hardwood forests and hammocks of west-central Florida (*Justicia cooleyi* habitat) exceptionally rich floras (Appendix 3, p.35). Sites with fern-rich sinkholes are especially important. One soil mapping unit on which upland hardwood forests occur, Williston Variant, has, according to the soil survey, severe limitations for building streets or structures because of the shallow depth to rock. The combination of rich floras and poor suitability for construction may make these sites especially appropriate for conservation.

2.5 **Plan acquisition/conservation efforts based upon results of additional surveys.** All but the initial acquisition efforts should be planned according to the results of intensive surveys directed at better understanding the distribution and habitat requirements of these species (task 3). Based upon the results of these surveys, acquisition strategies and target lands will probably shift. Detailed acquisition plans will be prepared by the acquiring agencies.

3. **Conduct additional surveys for new populations of the species.** Carefully search the upland hardwood forests and hammocks where *Justicia cooleyi* might occur in Hernando and neighboring counties. The recent documentation of this species in Sumter County by the Florida Natural Areas Inventory (FNAI) broadens the area of the survey to at least three counties: Citrus, Hernando, and Sumter (and possibly northeastern Pasco). Such a search in the summer/fall flowering season could be guided by the 1983 spring survey conducted by Steven Leonard for The Nature Conservancy. The Hernando County soil survey shows that the known localities for this plant are associated with several soil series grouped in two soil associations: Arredondo-Sparr-Kendrick and Nobleton-Blichton-Flemington. These soil associations cover most of central Hernando County and small areas in adjoining Citrus County (Soil Conservation Service 1977, 1988a, 1988b). The soil surveys, the most recently available aerial photography from the Florida Department of Transportation, and possibly maps by the Florida Game and Fresh Water Fish Commission based on satellite remote sensing data (i.e., Landsat) could be used to prioritize which areas should be searched. Because most land in this tri-county area is private, landowner permission must be obtained in order to adequately survey the sites. It is appropriate for scientists participating in this task to collect voucher specimens of these species for deposit in university herbaria. *Justicia cooleyi* is locally abundant, and collection of a limited number of specimens would provide both firm documentation of localities and provide useful material for plant systematic investigations.

The Florida Division of Forestry owns two sites that deserve to be searched for *Justica cooleyi*: "In Hernando and Citrus Counties, lying mostly within T21S, R19E, NE corner of Sec. 5, and T20S, R19E, SE corner of Sec.2 The habitat is typical of the hardwood hammocks in this area and lies over thinly covered limestone. Mineral rights to the land are owned by BLM and interest has been shown by mining interests in extracting rock from the site. In Citrus County, T20S, R19E, middle of Sec.31, and area known as Lizzie Hart Sink. a large upland hardwood forest in an area of limestone outcrops and caves. this area is protected from development, but widely used for recreation." (J. Blanchard, Div. of Forestry, *in litt.* 1994).

Searching for *Campanula robinsiae* may take several years. When plants are growing and flowering at a selected monitoring site (February to April), similar prairies and sinkhole lakes in the vicinity should be surveyed. It is suggested to begin the surveys (if landowner permission can be obtained) with ponds in the same drainage system as Burns Prairie. These ponds are: Rock Pond, an unnamed pond south of Chinsegut Nature Center, Wade Prairie, and Blue Sink. The survey could then be extended to other ponds and prairies that are in the

general area of currently known populations of this diminutive annual, such as Dry Prairie, Coogler Pond, Grassy Pond, May Prairie, McKethan Lake, Spring Lake Prairie, Simmons Prairie Lake, and Johnson Pond.

4. **Augment existing cultivated populations, including possible establishment of a germ plasm bank**. Although *Justicia cooleyi* is currently in cultivation at Bok Tower Gardens (BTG), *Campanula robinsiae* is not, to our knowledge, being cultivated by any known conservation-oriented gardens or individuals. If plans for the *in situ* management and protection of either species fails, and if no additional habitat can be acquired and/or conserved, it will be important to have these species in cultivation. Because the few natural populations are so poorly known (particularly *Campanula robinsiae*), there is virtually no data on variability of population sizes. Because these species occur over such a restricted geographical range, further destruction of the habitat of these species could prove catastrophic, possibly resulting in extinction. Therefore, efforts to maintain cultivated accessions of *Justicia cooleyi* at Bok Tower Gardens should be continued, and *Campanula robinsiae* should be added to their collection. As noted above, BTG is a responsible, professional horticultural facility and a member garden of the Center for Plant Conservation. Their new Curator of Endangered Plants has offered to include *C. robinsiae* in their collections. Some funding for the accession and long-term maintenance of both of the species should be provided to BTG as part of the recovery of these species. As with all sound conservation work, every effort should be made to ensure that collection and maintenance endeavors include representative (if not maximum) population and genetic diversity of these species.

5. **Develop plans for possible (re)introduction of plants into suitable habitats (includes ten year monitoring of existing and/or reintroduced populations)**. If no more than three populations of *Campanula robinsiae* or 10 populations of *Justicia cooleyi* can be located, even with intensive survey efforts, consideration should be given to attempting introduction or reintroduction. Although it will be impossible to accurately reconstruct the historic distributions of these species, it may be necessary to establish some additional populations in order to meet the recovery criteria and, thus, to ensure the survival of these species in perpetuity.

   5.1 **Assess ability of present habitat to support the species**. Depending upon the results of the surveys, the success of ongoing and newly implemented management procedures, and the ability to acquire and/or conserve more populations of the species, an evaluation of the long-term survival potential of the species should be made. This study should include the level of management, improvement of existing habitat, and future acquisition that can be accomplished or is potentially feasible to adequately recover the species. If these measures are deemed inadequate to recover either species, then reintroduction or *de novo* (new) introduction should be carefully considered.

5.2 **Assess feasibility and need of reintroductions.** When all pertinent data are available, the need and potential for reintroduction can be more soundly addressed. In the event that reintroduction is to be attempted, the following recovery actions should be implemented.

5.21 **Locate suitable/potential reintroduction sites.** If reintroductions are to be attempted, suitable habitat must be located that closely resembles sites where the plants are known to exist, and that can be adequately protected over the long term.

5.22 **Examine reintroduction techniques and sources of plant material available.** Professional botanists and horticulturists should evaluate the success of different cultivation (i.e., propagation), site preparation, and planting techniques. All available stocks of plant material for introduction, and their documented origins and overall genetic variability, should be examined. Decisions for what material to use in reintroductions should consider the proximity of collections (i.e., accessions) to the site of reintroduction.

5.23 **Establish a trial introduction program.** Design and implement a trial introduction program to meet data needs and to test methods.

5.24 **Develop and implement a reintroduction program.** Based upon the results and assessment of the trial program, a reintroduction program should be developed that provides for the total requirements of successful reintroduction. Some of the parameters will include: source of material, method of propagation, site selection and preparation, planting technique(s), establishment success, management strategies, and monitoring.

5.3 **Establish a monitoring program adequate to meet the recovery criteria.** Utilizing standardized monitoring methodology, adapted to the life history and habitat requirements of the two species, periodically monitor the natural and any introduced populations for successful recovery. The monitoring program will yield many benefits; for example, monitoring the phenology of *Campanula robinsiae* at a site such as Burns Prairie could (1) indicate when to search other sites, (2) allow for collection of scientific specimens, and (3) provide data on what conditions the plant requires for germination and growth. *Campanula robinsiae* seeds may germinate only under specific conditions that do not occur every year. If monitoring of the plant's phenology indicates this is so, then more detailed observations or experiments should be designed to determine how this plant's life cycle is regulated by its physical environment. Monitoring methods can be adapted from those used, and taught, by The Nature Conservancy (Rob Sutter and Doria Gordon, TNC, pers. comm.). The criteria established to assess the success of the recovery actions (including reintroduced populations) should be periodically evaluated and, if necessary, modified in revised editions of this plan. The entire recovery program will be subject to review based on results of the monitoring plan.

6. **Enforce protective legislation**. Neither species is particularly vulnerable to removal from its habitat for commercial purposes because, although both are apparently easily propagated and grown, they are of little to no ornamental value (R. McCartney *in litt.* 1986 [for *Justicia cooleyi*]). Thus, there should be little likelihood of violation of the interstate commerce prohibitions of the Endangered Species Act. Federal and state agencies owning habitat for this plant should be aware that removal or vandalism of any endangered plant from Federal land and violation of state protective measures for these plants (including removal from state or private land without landowners' written permission and a permit from the Florida Division of Plant Industry) violates the Endangered Species Act, as amended in 1988. Permits should be granted for legitimate scientific collection of these species.

   Any alterations to the wetlands inhabited by *Campanula robinsiae* that require Federal permit(s) must be reviewed under Section 7 of the Endangered Species Act.

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PART III. IMPLEMENTATION SCHEDULE

Priorities in column one of the following implementation schedule are assigned as follows:

Priority 1 An action that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future.

Priority 2 An action that must be taken to prevent a significant decline in species population/habitat quality or some other significant negative impact short of extinction.

Priority 3 All other actions necessary to provide for full recovery of the species.

Note: Each task in the Implementation Schedule is assigned a priority number. While the number reflects the importance of the activity, it **does not** relate to the order in which tasks will be accomplished.

Key to Acronyms used in this Implementation Schedule

Bot. Gard	Botanical Gardens (e.g., Bok Tower Gardens)
CARL	Conservation and Recreation Lands Program (State of Florida)
DCA	Department of Community Affairs (State of Florida)
DPI	Division of Plant Industry, Florida Department of Agriculture and Consumer Services
FDF	Florida Division of Forestry, Florida Department of Agriculture and Consumer Services
FDOT	Florida Department of Transportation
FNAI	Florida Natural Areas Inventory
FWS	U.S. Fish and Wildlife Service, Southeast Region
GFC	Florida Game and Fresh Water Fish Commission
LE	Law Enforcement, U.S. Fish and Wildlife Service, Southeast Region
Managing agencies	Government agencies owning or managing land in the Chinsegut Hill area: U.S. Dept. of Agriculture, Agricultural Research Service, Subtropical Agricultural Research Station; U.S. Dept. of Agriculture, Soil Conservation Service, Plant Materials Center; Florida Game and Fresh Water Fish Commission, Chinsegut Nature Center
SWFWMD	Southwest Florida Water Management District
TNC	The Nature Conservancy
Univ	University (or other) research organizations with plant systematics facilities
WRPC	Withlacoochee Regional Planning Council

IMPLEMENTATION SCHEDULE

Priority	Task #	Task Description	Task Duration (YRS)	Responsible agency	Cost estimates[4] ($000) by year					Comments
					yr.1	yr.2	yr.3	yr.4	yr.5	
1	1.1	Secure known sites within government-owned lands.	2	FWS,DPI,FDF, FDOT,GFC	5.0	5.0				Should be complete by year 2
1	1.21	Determine habitat and population/reproductive needs.	3	FWS, Univ.	7.5	7.5	5.0	5.0		
1	1.22	Study relationship between hydrology and reproductive success (*Campanula*).	3	FWS, Univ., SWFWMD	7.5	5.0	2.5	2.5		
1	1.31	Conduct site analyses (for government-owned lands).	2	FWS, Univ., TNC, SWFWMD	5.0					
1	1.321	Prepare management plan: actions to diminish threats.	2	FWS, Univ., TNC, SWFWMD, GFC		2.5	2.5	2.5	5.0	
1	1.322	Prepare management plan: control exotic species.	5	FWS, GFC, Univ., TNC, managing agencies	15.0	10.0	5.0	5.0	5.0	May be underestimate; pest plants are a major problem.
1	1.33	Implement management plan.	continuous	FWS, managing agencies						Long-term management.
1	2.1	Acquire private lands currently known to contain the species.	4	FWS, CARL, FNAI, SWFWMD, TNC						Any FWS funding is budgeted elsewhere. $150,000 minimum?
1	2.2	Locate suitable funding for land acquisition efforts.	2	FWS, CARL, FNAI SWFWMD, TNC						
1	2.3	Seek non-acquisition methods of protecting habitats.	continuous	FWS, SWFWMD, TNC, WRPC	5.0	5.0				Provide funds to TNC and others to seek agreements
1	2.4	Use governmental regulation to protect species and habitats.	ongoing/ continuous	FWS, DCA, DPI, GFC, SWFWMD, WRPC						

Priority	Task #	Task Description	Task Duration (YRS)	Responsible agency	Cost estimates[4] ($000) by year					Comments
					yr.1	yr.2	yr.3	yr.4	yr.5	
2	3	Conduct additional surveys for populations of the species.	3	FWS, FNAI, GFC	5.0	3.0	3.0			Further searches appear very worthwhile.
2	1.323	Develop education program for land managers.	2	FWS, SWFWMD, TNC (FDOT?)	2.0	2.0				
2	2.5	Phase acquisition efforts based upon results of surveys.	4	FWS, GFC, SWFWMD, TNC						
2	4	Augment existing cultivated populations; establish a germ plasm bank.	6 (continuous)	FWS, Bot. Gard, Univ.	10.0	10.0	5.0			
2	6	Arrange law enforcement.	ongoing/ continuous	DPI, FWS-LE						
2	5.1	Assess ability of habitat to support the species.	3	Univ.	3.0					Could be done at same time as 1.21 and 1.3
2	5.3	Establish monitoring program to meet recovery criteria.	10 (continuous)	FWS, TNC, Univ.	5.0	2.0	2.0			
3	5.21	Locate suitable/potential reintroduction sites.	2	FWS, FNAI, Univ.		2.0				
3	5.22	Reintroduction techniques and sources of plant material.	2	Bot.Gard, Univ.		2.0				
3	5.23	Establish trial introduction program.	2	FWS, Bot.Gard, TNC Univ.		3.0				
3	5.24	Develop and implement a reintroduction program.	5	Bot.Gard, TNC, Univ.			5.0	5.0	5.0	
3	1.23	Taxonomic/systematic studies	2	FNAI, Univ.	5.0	5.0				

[2] See "Key to Acronyms used in this Implementation Schedule", p. 26.

[3] Other agencies' responsibilities would be of a cooperative nature or projects funded under a contract or grant program. In some cases contracts could be let to universities or private enterprises.

[4] Estimates are for Fish and Wildlife Service funds only (in thousands).

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APPENDIX 1. State and Federally listed plants in Hernando and adjoining counties (Citrus, Pasco, and Sumter counties), and candidates for Federal listing.

Species (common name)	Status		Counties			
	USFWS	State	Hernando	Citrus	Pasco	Sumter
Agrimonia incisa incised groove-bur	C-2		X	X		
Asplenium auritum auricled spleenwort		E	X	X	X	X
Asplenium pumilum dwarf spleenwort		E	X	X		X
Blechnum occidentale sinkhole fern		E	X	X	X	
Campanula robinsiae Brooksville bellflower	E	E	X			
Coelorachis tuberculosa Piedmont jointgrass	C-2		X			
Dicerandra cornutissima longspurred mint	E	E				X
Digitaria floridana Florida crabgrass	C-2		X			
Justicia cooleyi Cooley's water-willow	E	E	X			X
Monotropsis reynoldsiae pygmy-pipes	C-2	E	X			
Nolina brittoniana Britton's bear-grass	E	E	X(?)			
Triphora craigheadii Craighead's nodding-caps	C-2	T	X	X		
Triphora rickettii Rickett's nodding caps	C-2	T	X			
Verbena (Glandularia) tampensis Tampa vervain	C-2	E	X	X	X	

E—endangered; T—threatened; C-2—Category-2 candidate for Federal listing (insufficient information on hand to prepare a listing proposal)

Sources: Wolfe (ed.) in press, Table 30, and Florida Natural Areas Inventory.

APPENDIX 2. Descriptions of *Campanula robinsiae* and *Justicia cooleyi*

Campanula robinsiae (Brooksville bellflower)

This description is adapted from Wunderlin et al. (1980), with additional information from Morin (1987) and other sources. *Campanula robinsiae* is an annual herb with a slender taproot and delicate roots.

Stems: main vegetative branches arise from the axils of the lower leaves on the first stem (Morin 1987). The stems are 1-15 cm tall, very slender, simple or branched at the base and above, faintly winged or 4-angled. The angles bear a few trichomes; the plant otherwise appears glabrous (Morin 1987). The plant may be submerged for part of its life, which may affect its growth. Some stems root at the nodes (Morin 1987).

Leaves are alternate and lack stipules (Morin 1987), the blades varying in size on different parts of the plant. Those on the lower part of the plant are ovate to elliptic-ovate, 6-12 mm long, those on the upper parts of the stem elliptic to lanceolate or linear-lanceolate, most with few remote gland-like teeth, or the upper leaves entire. Leaf size varies greatly from branch to branch in a single plant (Morin 1987).

Flowers are solitary, on axillary or terminal pedicels, 2-6 mm long (3-10 mm long [Morin 1987]). Steven Leonard discovered in 1983 that the plant has cleistogamous flowers (closed, self-pollinating flowers), which are quite small. No complete description of the cleistogamous flowers is available. This is the only North American *Campanula* with cleistogamous flowers (Morin 1987). On chasmogamous (open, cross-pollinating) flowers, the hypanthium is hemispheric at anthesis (flowering time), subglobose in fruit, and glabrous; sepals (hypanthium lobes) are five (Small 1933), lanceolate or subovate-lanceolate, about 1.5 mm long, acute, glabrous. Morin (1987) notes that "field-collected plants tended to a reduction in number of flower parts to four or three". The corolla is rotate-campanulate, "deep purple in the field" (Morin 1987) or "deep blue-violet, center whitish [Herbarium specimen J. Beckner 2565, 13 April 1983, USF]), 7-8 mm wide, lobes elliptic-ovate or elliptic-lanceolate, longer than the tube, obtuse or acute, faintly veined. The stamen filaments are subulate-filiform; anthers are linear, about 1 mm long, longer than the filaments; style slender-columnar; stigma curled backward. The pollen may have bifurcate spines on the surface (N. Morin 1987).

The fruit is a "slightly purplish" [herbarium specimen Beckner 2565], subglobose capsule about 2 mm in diameter, topped by a persistent calyx, opening by usually 3 large basal pores; seeds are numerous (Wunderlin et al. 1980).

The seeds are the smallest of any North American member of the genus, about 1 mm long, with a length/width ratio of 0.4. The seed is trigonous in cross section with protuberances on the angles (Shetler and Morin 1986).

Reproductive phenology: Steven Leonard observed cleistogamous flowering only on February 8 and 11, 1983 (specimens SWL #8004, FSU et al. and SWL #8010, VDB [letter from Leonard to Morin, copied in Morin 1987]). He found his first chasmogamous flower on February 23, 1983 (letter from Leonard to Morin)(Morin 1987). Flowering specimens have

also been collected 11 March 1983 (Nancy Morin 335, USF and presumably MO), 13 April 1983 (J. Beckner 2565, USF)(Wunderlin 1985), and 26 April 1958 (G. R. Cooley, C. E. Wood, and K. A. Wilson #6029, FSU,USF)(Wunderlin et al. 1980). Seed production proceeds while flowering continues.

Campanula robinsiae may be confused with *Campanula floridana*, which has very different seeds and leaves that are "much firmer than those of *C. robinsiae*" (Morin 1987).

Justicia cooleyi (Cooley's water-willow)

This description is modified from Kral (1983) with additions from Perkins (1978) as indicated. *Justicia cooleyi* is a perennial herb usually no more than 40 cm tall, with erect stems rising from decumbent bases that come from a slender, elongate shallow rhizome.

Stems: slender, somewhat quadrangular, spreading-hairy, green or tinged with red, somewhat zig-zag, the branches few, spreading-ascending.

Leaves: largest toward the middle and upper stem, short-stalked, blades ovate or lanceolate, up to 5 cm long, thin, spreading, the tips acuminate, the margins entire or wavy, ciliate, the bases short-attenuate, the surfaces bristly-hairy. The leaves contain numerous linear cystoliths which are visible on the surface of the blade as short brown lines (Perkins 1978).

Inflorescence: The long basal stalk of each flowering branch usually forks once to produce 2 flower stalks. Each flower stalk is zigzag, finely glandular-hairy, with several sessile flowers arranged at equal distances from each other (i.e., each flower stalk is a spike).

Flowers: The flowers somewhat resemble miniature snapdragons. They are perfect, zygomorphic, each with a few linear, sepal-like bracts about as long as the sepals. The 4 sepals are linear, 3-4 mm long, finely hairy, narrowly acute, erect. The corolla consists of a tube about 4.5 mm long and two lips, bringing the total length of the corolla to 7-8 mm (or 10 mm [Perkins 1978]). The corolla is bright lavender-rose (or deep reddish-purple, Munsell hue 10P 3/9, based on a specimen [Cooley, Ray & Eaton 6904, USF, FLAS, FSU] [05]). The lower lip is longer, with a strip of mottled lavender and white down its middle, 3-lobed. The upper lip is short-oblong, with an erect, emarginate tip. Stamens are 2, attached to the corolla, the anther sacs 2 on each filament tip, one smaller than the other. Ovary is superior, with 2 carpels, the style elongate-linear. All flower parts except the stamens are glandular-pilose.

Fruit: The capsule is broadly club-shaped, finely hairy, about 1.2 cm long, flattened, the 2 valves separating to reveal a few round, flattened, dark-brown seeds, the seed coat densely villous, the hairs bifurcated (or "anchor-shaped" [Perkins 1978]). These distinctive hairs may have to do with dispersal.

Phenology: Kral (1983), relying on sparse data, suggested a flowering season of August-December, or November-March. Specimen label data indicate flowering beginning by mid-August, flowering in mid-September, and flowering in February (Wunderlin et al. 1980).

Justicia cooleyi is distinguished from the only other *Justicia* in this area, *J. ovata*, "by its thinner leaves, its generally pilose-pubescent surfaces . . . its much smaller, much brighter colored corollas" and by the unique hairs on its seeds (Kral 1983).

APPENDIX 3. Summary of Site-Specific Management Recommendations, Planning and Water Management Situations (prepared, in part, by E. J. Chicardi on contract to the Florida Natural Areas Inventory)

Cooley's water-willow *(Justicia cooleyi)* and the Brooksville bellflower *(Campanula robinsiae)* are protected species of wildflowers apparently endemic to west-central Florida. Both are listed as "endangered" by the United States Fish and Wildlife Service (USFWS) and the Florida Department of Agriculture and Community Services (FDACS). The *Campanula* is known to occur on only three sites just north of Brooksville in Hernando County, and *J. cooleyi* on less than a dozen sites in Hernando County and on one site in Sumter County.

The *Justicia* is a plant of rich, often rocky mixed broadleaf forests and adjacent roadsides, where it frequently forms dense colonies. Typical canopy species of the wooded areas include oaks *(Quercus virginiana, Q. laurifolia, Q. nigra,* and *Q. michauxii),* American hornbeam *(Carpinus caroliniana),* sweetgum *(Liquidambar styraciflua),* pignut hickory *(Carya glabra),* and southern magnolia *(Magnolia grandiflora).* Winged elm *(Ulmus alata)* is always present as an understory shrub. Various herbs sharing the forest floors often include wild petunia *(Ruellia caroliniana),* elephant's-foot *(Elephantopus carolinianus),* wild coffee *(Psychotria nervosa),* Spanish needles *(Bidens alba* and *B. bipinnata),* frostweed *(Verbesina virginica),* spleenwort *(Asplenium platyneuron),* Venus' looking-glass *(Triodanis perfoliata),* and several low-growing grasses. Cooley's water-willow produces small, irregular, reddish-purple flowers from late August through early February.

Campanula robinsiae occurs along the margins of wet areas, often near the "high water mark." It blooms in the spring, and is generally only evident at that time.

Both of these species are imperiled because of their limited ranges. They are apparently unable to spread into other suitable areas, although *J. cooleyi* may be grown from seeds in garden areas. Much of the original range in Hernando County is being destroyed by mining operations, and housing and commercial developments may affect the areas that are currently forested tracts. Additionally, several sites are being invaded by exotic species, the effect of which is unknown at this time.

SITE EVALUATIONS

This survey was conducted to gather site-specific information for the USFWS Recovery Plan for these two species. At the onset of this project, there were eight known stations for *Justicia cooleyi* (Jc-1 through Jc-8) and three for *Campanula robinsiae* (Cr-1, 2, and 3), as provided by the Florida Natural Areas Inventory's data base. Each of these sites was reviewed to update population status and to establish management needs. Two new localities of *Justicia* were subsequently discovered during a preliminary survey near Brooksville.

Jc-1. Sumter County/Hwy 50 Site. This site probably represents the first known collection of *Justicia cooleyi*. John Kunkel Small reported the plant in 1924, which he did not describe to species, as occurring in a low hammock near Mascotte. This city lies about seven miles to the east in Lake County. Thus, this species is often ascribed to Lake County, although it has [probably] never been collected there. Four colonies exist within a half-mile stretch of Highway 50 approximately mid-way between the small towns of Mabel and Linden. Although no attempt has been made to count the number of plants in this area, I [Chicardi] estimate well over one thousand individuals.

Within the wooded areas to the north of Highway 50, the plants grow to about 30 cm in height and may be considered typical of the species. Along the highway right-of-way, however, the plants are kept "stunted" by occasional mowing and an annual application of herbicides by the Florida Department of Transportation (FDOT). There, they reach a height of less than 10 cm and grow more prostrately, but otherwise appear to produce normal numbers of flowers and fruits. These roadside colonies also contain larger numbers of individuals per area than the forested colonies. The wooded areas are currently grazed by cattle, although there appears to be little harvesting of the herbaceous species; the cattle spend more time in the pasturelands which surround the forests.

The FDOT has been applying herbicides to the right-of-way in this area every March for the past 8 years, according to Stephen Tonjes of FDOT Environmental Services. This has apparently not adversely affected the productivity of this population. Since the spraying is conducted after the species' reproductive cycle has effectively been completed and the above-ground portions naturally senesce, it has not destroyed the colonies along the roadsides. Spraying may, in fact, protect this population from encroachment by exotic species. It is unclear, though, what lingering effect there may be on seed viability and germination, and these dense colonies may be reproducing entirely vegetatively. Additional studies may prove helpful in investigating these relationships for future management strategies. In the meantime, it is recommended that no changes be made to the maintenance plan currently used by FDOT.

Jc-2. Croom Road Site. This site represents the southeastern extreme known population in the Hernando County megasite. It lies just north of Croom Road (CR 478), about 1.5 miles northeast of Brooksville. This rather small population (20 to 30 plants) of *Justicia* is found in the southwestern portion of a large (90-100 acres) forested tract. It is typical of *J. cooleyi* habitat, but also contains a fair number of Mariana maiden ferns *(Macrothelypteris torresiana)*. The colony is located along an old roadway or Jeep trail that adjoins Croom Road and is barred by a large, yellow gate.

Two imminent threats exist to this population: nearby development and invasion of exotic species. Several roadway easements have been cleared in this area, including one not more than 50 yards west of the *Justicia* station. Surveyors' stakes located nearby indicate that this site may be cleared in the near future. Two common and problematic exotic species are encroaching into this area as well. Skunk vine *(Paederia foetida)* is becoming all too common

throughout Hernando County. Its habit of forming dense ground cover often excludes native species. Although it has not reached such an advanced stage on this site, it bears careful observation. Air-potato *(Dioscorea bulbifera)* may be an even more severe "exclusion species" and occurs in fairly large numbers just south of the *Justicia* colony along the old roadway.

Because this is a fairly small population lying in an area soon to be developed (such a small development would not require addressing listed plant species), I recommend collection of seeds from this site for re-introduction into preservation areas. This may help to satisfy long-term protection of the species.

Jc-3. USDA Plant Materials Center. The U. S. Department of Agriculture has a Plant Materials Center located on a portion of the [former] Chinsegut Hill National Wildlife Refuge (CHNWR) property. The site lies approximately 0.6 miles south of CR 476 on the western side of US-41. The USDA staff have located 50+ plants along their North Nature Trail, between trail-markers 14 and 20. The habitat is typical for mixed broadleaf forests in this area.

Invasion of skunk vine is the only major threat to this population; however, it also appears that a fungal or bacterial disease afflicts a good percentage of individual plants in this location. The USDA is currently trying to identify the pathogen to prescribe an appropriate cure.

This area needs to be maintained in its natural state to ensure survival of the *Justicia cooleyi* population. Mostly, this would entail removal or control of the skunk vine and continued maintenance as is currently being used. This particular area should have a high priority for re-introduction [or population augmentation] attempts since it is currently given Federal protection and is maintained as a preserve.

Jc-4-6, Cr-2. Former Chinsegut Hill National Wildlife Refuge, North Slope [USDA Agricultural Research Service]. A fairly large (several thousand estimated) population of *Justicia* and an unknown number of *Campanula robinsiae* occupies a north-facing seepage slope area in the northwestern portion of the former CHNWR. The habitat lies just north of the nature trail area and just south of the pasturelands south of Lake Lindsey. It is covered by a canopy of large live oaks *(Q. virginiana)*. Three different records (Element Occurrences) were listed for *Justicia* in this area, thus the "Jc-4 through-6" site name.

This portion of the USDA property is fenced and closed to visitors, and it is used primarily for "animal husbandry" studies on Brahma bulls. The soil is relatively sandy and cattle trails course their way through the wooded area. There are also several eroded gullies from storm run-off in the western side of the station, and a culverted ravine crosses the site from southeast to northwest.

Because of the nature of the Chinsegut Hill property (i.e., since it was established in the 1880's as a botanical garden for the Robins family), exotic species invasion is [a] major problem on this site. The "nature trails" area is completely covered by a dense growth of *Dioscorea,*

wandering jew *(Tradescantia fluminensis),* and skunk vine, with scattered clumps of banana *(Musa nana),* sago palms *(Cycas* sp.), and bamboo *(Bambusa* sp.) in the eastern half. A graveled road separates this exotic milieu from the *Justicia* and *Campanula* station and has fortunately precluded all but the skunk vine from covering this area. Control of exotics should be the main focus of preserve management on this otherwise protected site.

Jc-7. Cooley's Indian Hill Collection Site. G. R. Cooley collected specimen's of his "new" species of *Justicia* in 1959 from deciduous woods approximately 2 miles northwest of Chinsegut Hill and 1 mile south of the Citrus County line. From these "type specimens," Monachino and Leonard named the species in Cooley's honor.

This collection site occupied a portion of what is now the Brooksville Quarry, a mining operation run by Florida Rock. Aerial photography from 1980 shows that the vast majority of *Justicia cooleyi* habitat in this area had been destroyed or greatly reduced, with greater destruction likely in the 12 years since then. Some areas harboring populations of this species may persist; however, repeated attempts to gain access through the mining property by myself and others have been met with futility. This is not surprising, given the currently proposed Hernando County "Mining Ordinance," which will probably cause major issues to be addressed by mining companies in the future. . .

In light of these issues and the widespread mining that has already occurred, this site is probably best "written-off," with energies spent protecting the species on undeveloped sites.

Jc-8. Brooksville--US-98 Site. This tiny station occupies the northeastern corner of a square, 10-acre, wooded tract that is crossed by U.S. Highway 98 approximately one-quarter mile southeast of CR 491. A wet depressional area is noticeable from the highway, and the *Justicia* forms a large colony just to the east of the wet area. A fenceline separates the disturbed right-of-way, which still has a few large trees and shrubs, from a wooded area grazed by cattle. An access road runs parallel to and just south of the fenceline. Several hundred to perhaps over 1,000 *J. cooleyi* occur in this area. Oaks, hickory, and sweetgum are the dominant trees, and *Bidens alba* and beggar-ticks *(Desmodium* sp.) are frequent in the grassy disturbed area. No *Justicia* were found on the south side of US-98 in the larger wooded tract (where southern sugar maple *[Acer saccharum]* is prevalent).

Invasion of skunk vine is a major concern in this area; the disturbed grassy area is rapidly becoming choked with it. Management of this area may be difficult, since the largest number of individuals occur between the forested area and the US-98 right-of-way.

Cr-1. Allman Road Site. A small (ca. 5-acre) pond is found in the northern section of a cattle pasture on the south side of Allman Road (CR 476A) just west of CR 481. *Campanula robinsiae* has been collected from the margins of this pond, at about the high water level, where the dark muck of the pond bottom joins the light sand of the surrounding pasture area. Cypress *(Taxodium distichum* var. *nutans)* and buttonbush *(Cephalanthus occidentalis)* occur in the pond,

and mosquito fern *(Azolla caroliniana)* covers the surface. John Beckner found several thousand *Campanula* in this area in April, 1983. Because of the flowering season and annual nature of this species, none were located during my evaluation of this site.

Although cattle trample the margins of this pond, this does not appear to adversely affect the *Campanula*. There was no invasion by exotic species noted, and so long as this site remains a cattle pasture there are no imminent threats to the *Campanula robinsiae* population.

Cr-3. Burns Prairie Site. Burns Prairie encompasses several grassy marshes and ponded areas in the southern sections of the Chinsegut Hill National Wildlife Refuge property. Much of this area consists of cattle pastures and forested tracts that are fenced by the USDA. The *Campanula* station lies along the northeastern shore of an elongated maidencane *(Panicum hemitomon)* marsh approximately three-quarters of a mile west by southwest of the intersection of CR 481 with US-41. This area is bordered by a thin strip of oak hammock to the east. No *Campanula* was located during this Fall, 1992 survey.

As in the CHNWR North Slope station and Allman Road site, management of this area for cattle does not appear to have a deleterious effect on *Campanula robinsiae*. Additional surveys and studies of this species during the Spring will likely prove invaluable in understanding its requirements and management needs.

DISCUSSION

During my attempt to gain insight into management issues and regulatory agencies' jurisdiction over the stations for *Justicia cooleyi* and *Campanula robinsiae,* I consulted with Hernando and Sumter County Planning Departments, the Southwest Florida Water Management District (SWFWMD), the Withlacoochee Regional Planning Council (WRPC), FDACS, and the FDOT, as well as the management staff for the USDA Agricultural Research Service and the USDA Plant Materials Center.

Basically, the regulatory agencies may exercise jurisdiction over listed species of plants only when large developments are proposed (Planning Departments and WRPC) or if the species are listed as wetland-dependent by the SWFWMD [or if collection of State-listed endangered plants is planned. DPI regulations require a permit for collection of endangered plant species and provide penalties for violation--Nancy Coile, Fla. Dept. Agric. and Consumer Services, Division of Plant Industry, pers. comm. 1994]. Neither the *Justicia* nor the *Campanula* are listed by the SWFWMD, and stormwater run-off and management regulations do not apply to these species. The Sumter County Comprehensive Plan addresses the protected species issue, but requires a review only for developments greater than 50 units or for "large commercial" developments. . . Smaller developments and individual landowners require no regulations. Hernando County will be addressing the issue of upland plant community preservation in their proposed "Mining Ordinance." Several different versions of this ordinance have been submitted by various interests--including the mining companies themselves--and will likely not be even considered until after the November [1992]

elections. The County's plan includes requiring a survey for listed species by "qualified and approved biologists" of lands slated for mining.

The WRPC enforces other agencies' regulations (particularly the USFWS guidelines, according to Charles Harwood, Council Chairman) pursuant to the Florida Administrative Procedures Act. As a part of this process, the Council recognizes species that local governments take into account, even though these species may not be listed by the USFWS or FDACS.

With the exception of the CHNWR stations, all confirmed localities of these two endangered species occur on private lands, and only one of these stations is not currently being grazed, at least in part, by cattle. There may be some protection offered by ranchers who continue to raise cattle rather than "sell-out" to developers.

The major management concern, therefore, is focused on the removal and/or control of exotic species, especially skunk vine and air-potato. Studies centering around controlled application of herbicides during *Justicia's* dormant period (as occurs at the Sumter county site) combined with seed viability tests may indicate management techniques to be administered (or forsaken) in preserve areas.